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Published in:
Book of Abstracts

Publication date:
2014

Document Version
Publisher's PDF, also known as Version of record

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MOTION OF SINGLE PARTICLE IN OSCILLATORY FLOW OVER A SMOOTH BED

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The motion of single particle near the bed has been tracked in an oscillating water tunnel. The experiment is an extension of the work done by Sumer and Deigaard (1982) and more recently Niño and Garcia (1996) where the motion of single particles were studied in open channel flows. However the particle motion is also depending on the phase in oscillatory motion.

The experiment is conducted in an oscillating water tunnel with a cross section of 0.4m x 0.29m (width x height) and a 10 meter long working section. The period T was 9.73s which corresponds to the natural period of the tunnel. The Reynolds number, $Re = U_{0m} a/\nu$, where U_{0m} is the free stream velocity, $a = U_{0m}T/(2\pi)$ is the stroke of the motion and ν is the kinematic viscosity of water, ranges from $Re = 10^5$ to 10^6. The particle motion has been recorded with a standard video camera and afterwards the particle path has been tracked in Matlab by modifying a simple particle tracking software by Pastor (2013).

The results show that in the beginning of the half cycle the particle moves near the bed and when the flow becomes turbulent the particle will at some point "take off" from the bed and brought into suspension. The statistic for the particle position over the depth is worked out as function of phase. Two parameters govern the particle motion namely w/U_f (settling velocity/friction velocity) and Shields parameter, $\theta=U_f^2/(g(s\text{-}1)d$ (g is acceleration due to gravity, s is the specific gravity and d is the diameter of the particle). Based on the particle position the acceleration is determined. The latter is used in conjunction with the vertical component of the equation of motion for the particle.

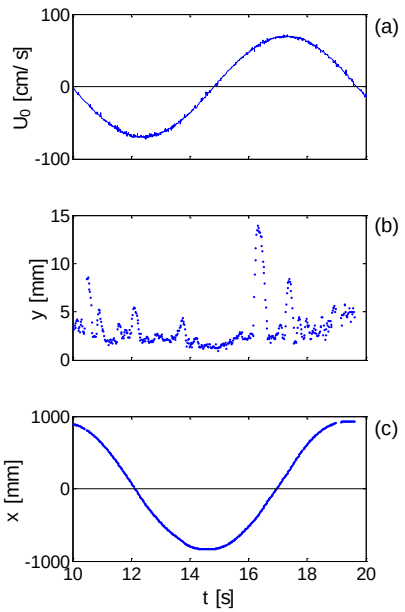

Figure 1 (a): Free stream velocity (reference signal); (b) particle path in the horizontal direction. x=0 corresponds to the midpoint of the tunnel; (c) particle path in the vertical direction. y=0 corresponds to the bed.

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Niño Y. and Garcia M. H., 1996, Experiments on particle-turbulence interactions in the near-wall region of an open channel flow: implications for sediment transport, *J. Fluid Mech.*
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